

the only OARs to be significantly affected by applying these moves and in these cases no clinically significant deviations were observed.

Conclusions: Variations in the factors investigated, do not correlate with tumour motion within DIBH. The diaphragm is not stable within BH. Applying soft tissue moves is safe to surrounding OARs once due clinical attention is paid to close critical structures.

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Inter-observer variability study for daily CBCT registration of VMAT prostate treatment

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Purpose/Objective: This work evaluated the inter-observer variability in CBCT registration for prostate patients treated with IMRT (Intensity Modulated Radiation Therapy). We also demonstrated the importance of daily CBCT registration for this treatment.

Materials and Methods: In the first study VMAT plans were produced for 2 prostate cancer patients and a voluntary shift of the isocenter was introduced in the anterior/posterior direction. A total of 22 different VMAT plans were evaluated with 13 plans for the first patient and 9 plans for the second. In the second study, 12 technologists each registered 22 CBCT for 22 different prostate patients. Medical doctors have done the same registrations that was considered as the Gold Standard reference. Registration was done using bony anatomy and adjustments made on by the user on evaluation of the rectum and prostate. Shifts in all three axis were documented for a total of 286 CBCT. Two statistical methods were used to analyse the results. The first was the 95 percentile to calculate the minimum threshold under which the users found similar values. The second was the ANOVA test, followed by the Post-Hoc/Bonferroni test. These tests were used to find differences in inter-observer registration variability and determine whether any individual users performed registrations which differed significantly from those of the other users.

Results: The dosimetric study showed that a shift of 5 mm in the posterior direction was enough to deliver a higher dose than acceptable to the rectum in both cases. A different threshold was found by shifting anteriorly, ranging from 5 mm for patient B to 12 mm for patient A. On the other hand, the statistical analysis of the registration study showed that using the 95 percentile, threshold values were demonstrated of 2.1, 3.5 and 7.3 mm in the left/right, target/gun and anterior/posterior respectively. The Anova test showed a low p-value in the target/gun axis but using the Post-Hoc analysis there were no significant differences between the technologists and the medical doctors.

Conclusions: This study showed the importance of a daily CBCT/CT registration in prostate radiation treatment. The different studies also showed that partial delegation of the prostate registration to the technologists is feasible under some security thresholds. However, regular training and evaluation should be done by the medical doctors and physicists.

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The need for quality assurance of the image guidance process in radiotherapy

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Purpose/Objective: A higher awareness of changing anatomy has resulted in an increased complexity and a continuous change of the image guided radiotherapy (IGRT) process. To guarantee the quality of this process we developed a quality assurance (QA) program which involves 1) Inspection of the clinical IGRT process; 2) A check to assess if certain structural abnormalities occur in specific patient groups. This study describes the methodology of our QA program and the results after the first 8 months.

Materials and Methods: Each member of the IGRT group performed QA tasks once a week for 4 hours. A checklist was used to assess whether the IGRT process was performed according to protocol and to verify whether there were other abnormalities present. This checklist was developed within an interdisciplinary group discussion. Results of the QA program were documented in an in-house developed computer program.

The following items were monitored: 1) The number of errors in the IGRT preparation and execution process. 2) Anatomical and other potential dose altering changes that occurred during treatment. Monthly, results were discussed with the members of the IGRT group and, if necessary, feedback is given to the department. After the first 8 months, all QA findings were presented on a departmental level. **Results:** In an 8 month period 5 dedicated RTTs, all IGRT working group members, reviewed 154 patients with a total of 609 CBCTs, including breast, lung, rectum, oesophagus, gynaecological, bladder and central nervous system patients.

- In 12% of the patients (n=43) anatomical changes were found, mainly in patients treated for lung or oesophagus cancer. 3% of the whole reviewed population needed replanning during treatment.

- 7.2 % of the patients showed a change in body contour larger than 1 cm because of weight difference or seroma change.

- 17% of the patients showed irregularities in the IGRT preparation process. E.g. registration areas, defining the correct clipbox, correction reference point or match algorithm, were not defined according to protocol. These figures gave us a better insight regarding the IGRT process.

- In 3% of all the CBCTs rotation values were more than 4 degrees (the upper limit for acceptable rotations) the majority (77%) around the left-right axis.

- In 1.6% of the CBCTs a part of the CTV was outside the PTV as a result of tumor progression, tumor shift, or changes in seroma.

- 5 patients showed undetected lesions in the lung. In 2 patients after further examination these proved to be malignant.

Conclusions: The results of the QA program indicates that a substantial part of the treated population show changes which potentially alter dose delivery. In 3% of the investigated population rescanning and replanning was considered necessary.